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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Regina Keeney, Chief
International Bureau
Federal Communications Commission
2000 M Street, NW
Washington, D.C. 20554

Re: **SkyBridge L.L.C.**
RM No. 9147

Dear Ms. Keeney:

Diversified Communication engineering, Inc. ("DCE"), through counsel, hereby submits a copy of its Progress Report for Experimental License WA2XMY in the above-referenced proceeding. The report was filed on January 8, 1998 with the Experimental Licensing Branch. The report sets forth the results of tests conducted by DCE of its "Northpoint" technology from October 6 to 10, 1997. As described in detail in the report, the test demonstrated that terrestrially broadcast signals can be transmitted and received on the same frequencies as Direct Broadcast Satellite ("DBS") signals without causing interference into DBS receivers.

DCE has previously requested that the Commission withhold any action in the referenced proceeding that would foreclose the evaluation and implementation of Northpoint, which promises far greater public interest benefits than the SkyBridge proposal. See Reply Comments of Diversified Communication Engineering, Inc.--Northpoint, filed September 11, 1997 in RM No. 9147 and Response of Diversified Communication Engineering, Inc.--Northpoint, filed December 3, 1997 in RM No. 9147; Letter to Regina Keeney dated January

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15, 1998 in RM 9147. Now that the technical feasibility of Northpoint has been empirically established, DCE will soon request that the Commission initiate an appropriate proceeding to fully evaluate the technology and to establish service rules for implementation of Northpoint.

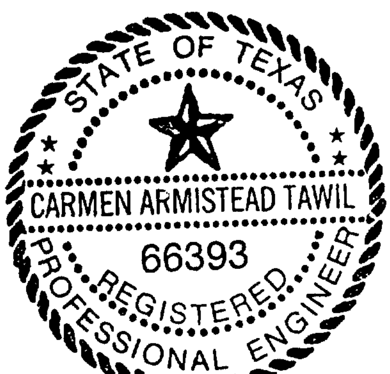
Respectfully submitted,

James F. Ireland

James F. Ireland

PROGRESS REPORT
WA2XMY

PREPARED BY:
DIVERSIFIED COMMUNICATION ENGINEERING, INC.
CARMEN A. TAWIL, P.E.
VICE PRESIDENT



PROGRESS REPORT
TO THE FEDERAL COMMUNICATIONS COMMISSION
ON EXPERIMENTAL LICENSE WA2XMY

PURPOSE AND BACKGROUND

In November of 1995, Diversified Communication Engineering, Inc. (DCE) applied to the Federal Communications Commission (FCC) for an Experimental License to conduct tests in order to verify the validity of a concept of usable, simultaneous terrestrial and satellite co-channel transmissions. Specifically, the Experimental License was needed to investigate whether terrestrially broadcast signals could be transmitted and received on the same frequencies as Direct Broadcast Satellite (DBS) signals without causing interference into any DBS receivers.

In brief, DCE's "Northpoint" technology relies on the premise that terrestrial transmitters can be deployed in a manner that uses directional antennas, in conjunction with known satellite positions, to provide terrestrial signals to the satellite receivers. In effect, any terrestrial transmitter will have associated with it an "exclusion zone," an area where signals from the terrestrial transmitter will cause harmful interference to DBS reception, and a "service area," an area where signals from the terrestrial transmitter will be sufficiently strong to be received. Northpoint technology relies upon using the known "look angle" and orientation of the DBS receiver to create, effectively, a land-based satellite "orbital slot." By using directional antennas and orienting the transmissions in a southerly direction, Northpoint technology was developed to minimize the "exclusion zone" for a given "service area." The determination of the exclusion zone size and the resulting proportional service area were the primary concerns to be addressed by the instant Experimental License.

The original Experimental License application requested that the tests be conducted in Austin, Texas which is where DCE maintains offices. After a meeting with FCC staff, the Experimental License application was amended to specify a test site on the King Ranch near Kingsville, Texas. The King Ranch is a large privately owned tract of land in a remote, rural area of south Texas and was chosen in order to address FCC concerns that the test not interfere with existing DBS subscribers.

On July 8, 1997, the Experimental License, call sign WA2XMY, was granted and shortly thereafter the equipment needed to conduct the test was ordered. In order to establish independent verification of the test and results, the nationally recognized engineering and communication services firm, Comsearch, was engaged to perform the tests.

The tests were conducted the week of October 6, 1997. As required by conditions of the Experimental License, notices were placed in every issue of the twice weekly newspaper which serves the area, The Kingsville Record, for two weeks preceding the test and also during the week of the test, notifying DBS subscribers about the test and giving a local phone number to call with interference complaints. Also, as required, a mailing went out the week preceding the test to all homes within the predicted potential interference area detailing the days and times of the test and giving a local phone number to call in case of interference. A condition of the Experimental License was the requirement that if any DBS subscriber experienced interference during the testing, the transmitter would immediately be shut down and the complaint would be investigated. No interference calls were received during the tests.

INTERFERENCE CRITERIA

On April 11, 1994, DirecTV submitted a report to the FCC entitled "Terrestrial Interference in the DBS Downlink Band". The DirecTV report represents the state of the art prior to the development of Northpoint technology. We have used it as a reference source for certain technical parameters and as a measure of the benefits of Northpoint technology.

The DirecTV report analyzed the impact of *indiscriminately positioned* (with respect to DBS users) relatively high power two-way terrestrial microwave links in the DBS band. Since this report analyzed the impact of existing microwave paths that were in use by third parties, DirecTV was not able to dynamically control the transmitter power output or the transmit antenna direction to more closely establish an actual interfering signal level threshold.

The referenced report stated that "A complete loss of video transmission...will result when the interfering sources produce power levels that approach 10 dB below that of the desired satellite transponder signals at the Low Noise Bandwidth (LNB) input." Thus, it was reported that a Carrier to Noise + Interference ratio (C/(N+I)) of 10 dB is required to avoid "...complete loss of video transmission". This same report, while discussing an interference example, stated that the "received C/(N+I) is less than 5 dB, well below the demodulator lock threshold at approximately 8 dB of C/N.".

The DirecTV report further stated that "(s)evere rain attenuation or interference will cause loss of picture. This will occur at carrier to noise plus interference ratios below 5 to 8 dB. The exact threshold point depends on the particular hardware's performance and mode of operation."

The typical example in this report listed a 1 watt terrestrial transmitter with a 6' diameter parabolic transmit antenna resulting in an Effective Isotropic Radiated Power (EIRP) of 45 dBw, orientated in a northerly transmit direction. The system described in this example would cause interference to DBS users whose dishes are pointed within or close to the boresite of the transmit antenna. However, it was a purpose of the instant Experimental License operations to demonstrate Northpoint technology -- i.e., that a properly engineered (both in EIRP and transmit direction) terrestrial transmitter can co-exist with and augment the DBS services by providing local insertion possibilities.

A real world example used in the DirecTV report stated that a northerly orientated, 48 dBw EIRP terrestrial link which passes by the DirecTV headquarters in Los Angeles at 12 degrees off center line to the beam peak "... does not cause measurable degradation to the overall DBS link C/(N+I)." In contrast, the technology implemented under this Experimental License, Northpoint uses a directional transmit antenna orientated in a southerly direction and an EIRP that is more than 40 dB lower than the transmitter referenced in the DirecTV report.

As a supplement to the Experimental License application, DCE engaged DeLawder Communications, Inc. to prepare a report that analyzed the potential interference of the Northpoint test utilizing the interference criteria as stated in the referenced DirecTV report. The DeLawder report included coverage maps, using the most conservative C/(N+I) ratio required according to the report of 10 dB, indicating where a potential "exclusion zone" or interfering area would occur around the transmit site for both DirecTV and EchoStar DBS subscribers.

One of the main purposes of the Experimental License test was to verify empirically the interference criteria reported in the DirecTV report to the FCC, and thus establish a known exclusion zone, with a corresponding practical service area, for a particular transmit EIRP and transmit direction. The measurement criteria used to establish interference levels included feeding the output of the LNB to both the spectrum analyzer and the receiver/decoder with a power divider. In this way, power measurements could be read and recorded while the DBS receiver/decoder was subjected to a known interfering signal. At the same time that measurements were being made on the spectrum analyzer, a visual observation of the DBS receiver/decoder output on a video/audio monitor was made. (See Comsearch Figure 2.5-1). The EIRP of the interfering signal was then lowered until the DBS receiver was able to achieve demodulation lock and a good, no freeze-frame, video/audio signal. By analyzing the spectrum analyzer traces for both the satellite and the terrestrial signal it was determined that the actual C/(N+I) required for demodulation lock and no visually noticeable degradation of the DBS signal was actually just under 5 dB.

A preferable way of determining objectionable interference, performing a Bit Error Rate (BER) test, would require cooperation from the DBS operators. The DBS operators would insert a test signal into one of their satellite signals and a comparison would be made of the resultant errors added by the terrestrial signal versus the BER without a terrestrially transmitted co-channel. The next phase of tests will therefore attempt to include the cooperation and participation of DBS providers to better determine any possible impact on their subscribers.

TEST CONDITIONS

As previously stated, the test was conducted in a very rural environment and with almost flat terrain. Therefore, it was not possible to test at this location for the impact of building and other structural reflections that could possibly affect the outcome of the test. Thus, DCE plans to conduct follow-up tests in a more urban environment to test for multi-pathing due to reflections.

In terms of weather, torrential, record breaking rains and dense cloud cover were experienced throughout the week of the test. While this made for very unpleasant work conditions, it provided an ideal environment for testing terrestrial interference into DBS receivers by providing real time rain attenuation conditions. Atmospherically, this weather was the "worst case" for Northpoint technology, because of the reduced margin for DBS signal reception.

EQUIPMENT USED FOR THE TEST

The following transmission and reception equipment were used during the test:

1) 1 Watt LNR transmitter w/digital encoder, QPSK modulation and Power Level Control

2) Seavey Engineering custom horn antenna w/10 dB gain, 110 degree horizontal beamwidth and 17 degree vertical beamwidth

3) 70' of Andrew EW127 waveguide with WR75 flanges

4) RCA DBS antenna and LNB

5) DirecTV DBS receiver/decoder

6) EchoStar DBS receiver/decoder

7) Tandberg TT1200 MPEG2-DVB receiver/decoder

8) Sony color video/audio monitor

The test equipment utilized included the following:

1) Tektronix 494P spectrum analyzer w/C5C camera

2) Hewlett-Packard HP8672A synthesizer

3) Hewlett-Packard HP436A power meter w/8481A sensor

4) Amplica AXM 545302 LNA

5) Ailtech 91892-1 reflector w/94614-1 horn w/34 dB gain at 12.5 GHz, 4 degree beamwidth

6) 25' and 10' of Andrew FSJ4 1/2" cable

7) 2 way power divider

TEST SETUP

The Comsearch Senior Field Engineer (Comsearch Engineer) first calibrated the LNR transmitter output power and verified that the transmitter had an output level at full power of 29 dBm. See Comsearch Figure 2.2-2. The transmit antenna was then connected to the transmitter with 70 feet of waveguide and WR75 flanges with a resulting estimated line loss of 2.5 dB. See Comsearch Figure 2.2-3. The transmit antenna was mounted on a boom lift which was then elevated to 52' AGL, and positioned on a center azimuth of 180 degrees true, with horizontal polarity.

The Comsearch Engineer then calibrated the Comsearch 12.5 GHz Test System utilizing both the 25' and the 10' cables and established an isotropic top reference on the spectrum analyzer. See Comsearch Figure 2.3-3 & Figure 2.3-4. The Comsearch Test System would be used at each test site to establish and verify the isotropic received signal level (RSL) from the transmitter with line-of-sight conditions.

In order to determine the effect of any testing on the DBS systems, it was necessary to determine which channel or channels would be impacted by a particular transmit frequency. Because neither DirecTV nor EchoStar will release channel loading information, the test channels affected were determined empirically. Prior to arriving on location to conduct the test, the Comsearch Engineer performed tests on a DirecTV DBS system to determine channel loading information and determined that 12470 MHz was near mid-transponder for the DirecTV transponder that carries Channel 242. The test frequency and channel affected for EchoStar were determined in the field during testing and it was determined that 12460 MHz was near mid-transponder for the EchoStar transponder that carries Channel 220. Since the DBS modulation is TDMA, an interfering signal in any portion of the transponder will affect all channels on that transponder equally. Thus, if one channel experiences interference, all channels are similarly affected. See DirecTV's "Terrestrial Interference in the DBS Downlink Band", Section 2.4.

Based upon these results, when testing the DirecTV DBS system, the terrestrial transmitter was tuned to 12470 MHz and perceptible interference was observed on Channel 242. When testing the EchoStar DBS system, the terrestrial transmitter was tuned to 12460 MHz and perceptible interference was observed on Channel 220.

For the test site geographic location, in order to receive DirecTV, the DBS antenna must be positioned at an elevation of 58 degrees and an azimuth of 186 degrees. In order to receive EchoStar, the DBS antenna must be positioned at an elevation of 56 degrees and an azimuth of 205 degrees.

During the tests, the terrestrial transmitter was set at 8 MHz bandwidth, the satellite carriers used a bandwidth of 24 MHz, and the spectrum analyzer resolution bandwidth was set to 1 MHz. A correction factor of 10 X log(Signal Bandwidth/Resolution Bandwidth), expressed in dB, is therefore required for the spectrum analyzer display. The resulting correction factor for the 8 MHz signal was therefore 9 dB, while the correction factor for the 24 MHz signal was 13.8 dB. Thus, when the two signals appeared on the spectrum analyzer at apparently the same power level, they were actually 4.8 dB apart. (See Comsearch Sections 1.3 & 4.1)

TEST PROCEDURE AND RESULTS

Once the transmitter and the Comsearch Test System were calibrated, the test measurements were ready to begin. The first test location was chosen 1 mile due south of the transmit site with clear line-of-sight to the transmitter. (Comsearch reference site 7, See Comsearch Figure 2.6-1). With the terrestrial transmitter turned off, the DirecTV system was aligned and was set to peak performance using the display on the spectrum analyzer. With the DirecTV system peaked and the output of the receiver/decoder connected to a video monitor, the terrestrial transmitter was then turned on to full power of 29 dBm (36.5 dBm EIRP) and was set at 12470 MHz. The terrestrial RSL was determined to be -82 dBmi at this location.

This site was well within the estimated DirecTV exclusion zone as calculated by DeLawder utilizing the DirecTV interference criteria, the look angle for DirecTV DBS subscribers at this location and the published receive antenna characteristics included in the DirecTV report. (See DirecTV Figure 2.3-1). However, no interference was observed in the DirecTV DBS signal with the terrestrial signal at full transmit power of 29 dBm (36.5 dBm EIRP). (See Comsearch Figure 3.1-11(A)).

For EchoStar, this first site at 1 mile was also well within the predicted exclusion zone. Interference was observed in the EchoStar DBS receiver/decoder at full power but was eliminated by lowering the terrestrial transmitter power level. (See Comsearch Figure 3.1-11(B)).

With such promising results at the 1 mile site, it was decided to choose the second test site (Comsearch reference site 8) at 1/4 mile due south of the transmitter site. Since the EchoStar DBS receiver/decoder was more susceptible to interference in this direction, the EchoStar DBS receiver set up was used to determine the 1/4 mile transmit EIRP that would not cause noticeable interference. It was determined that a transmit power of 5 dBm (12.5 dBm EIRP) did not cause noticeable interference into the EchoStar DBS receiver/decoder at 1/4 mile at an azimuth of 0 degrees to the transmitter. (See Comsearch Figure 3.1-13 (A)). By raising the transmitter output power to 7 dBm (14.5 dBm EIRP) with a resulting C/(N+I) of less than 3 dB, the EchoStar DBS receiver/decoder could not achieve demodulation lock. (See Comsearch Figure 3.1-13 (B)).

Based upon transmit power yielding an "exclusion zone" of ¼ mile (1320'), DCE then decided to conduct tests at a site that was a distance of approximately 10 miles from the transmitter (Comsearch reference site 13, See Comsearch Figure 2.7-1), with the transmitter power output set at 5 dBm (12.5 dBm EIRP) to see if a usable terrestrial signal could be received. Terrestrial signal reception and the resulting video/audio quality proved to be excellent at this distance and power, even with significant power lost in foliage blockage due to the fact that the transmitter was only 52' AGL and the receive antenna was at 9' AGL. (See Comsearch Figure 3.1-22 (A)). It is very likely that with line-of-sight conditions, a practical service area could extend well beyond 10 miles.

Additional test sites were selected at different azimuths around the transmitter with RSL readings taken and interference tests performed on the DirecTV and EchoStar DBS systems. Comsearch reference site 4, was located 1.19 miles (6330') from the transmitter at an azimuth of 123 degrees. This site was outside of the main antenna beamwidth - the 3 dB point being at an azimuth of 125 degrees from the transmitter. This site had a terrestrial RSL of -96 dBmi at full transmitter power output of 29 dBm (36.5 dBm EIRP). (See Comsearch Figure 3.1-5 (A)). This transmitter power level caused no perceptible interference into either the DirecTV or the EchoStar DBS receivers/decoders. (See Comsearch Figures 3.1-6 (A) & (B)).

Comsearch reference site 5, located at 1.4 miles (7400') from the transmitter at an azimuth of 156 degrees from the transmitter had a RSL of -87 dBmi at full transmitter power. (See Comsearch Figure 3.1-7 (A)). There was no perceptible interference into the EchoStar receiver/decoder at this power level. (See Comsearch Figure 3.1-8 (B)). However, there was interference into the DirecTV receiver/decoder. In order to eliminate the interference into the DirecTV receiver/decoder, the transmitter output power was reduced to 20 dBm (27.5 dBm EIRP). (See Comsearch Figure 3.1-8 (A)). This reduced transmit power level is still 15 dB higher than what was needed to achieve a good quality signal at almost 10 miles.

Comsearch reference site 3, located at 1/4 mile (1320') from the transmitter at an azimuth of 143 degrees had a RSL of -73 dBmi at full transmitter power. (See

Comsearch Figure 3.1-3 (A)). It was necessary to go to 11 dBm transmitter power output (18.5 dBm EIRP) in order to not interfere with DirecTV and 9 dBm transmitter power output (16.5 dBm EIRP) to not interfere with EchoStar. (See Comsearch Figures 3.1-4 (A) & (B)). Once again, these transmitter power output levels still exceed what is needed to achieve a service area of at least 10 miles.

Comsearch reference site 9, located 600' from the transmitter at an azimuth of 250 degrees from the transmitter was outside of the main beamwidth of the transmit antenna by 15 degrees. The terrestrial RSL at this site was -96 dBmi at a transmitter power output of 9 dBm (16.5 dBm EIRP) and did not cause perceptible interference into either the DirecTV or the EchoStar receivers/decoders. (See Comsearch Figures 3.1-15 (A) & (B)).

Since the DBS antennas must be pointed in a southerly direction, four test sites north of, and within close proximity to, the transmitter site were chosen to analyze the impact of the terrestrial signal on the DirecTV and EchoStar systems. Comsearch reference site 2 was located 1800' at an azimuth of 42 degrees from the transmitter site. The RSL at this site was -92 dBmi at full transmitter output power of 29 dBm (36.5 dBm EIRP). (See Comsearch Figure 3.1-1 (A)). Neither the DirecTV nor the EchoStar DBS receivers/decoders experienced interference at full transmitter power output. (See Comsearch Figures 3.1-2 (A) & (B)).

Comsearch reference site 10 was located 610' from the transmit site at an azimuth of 312 degrees. This site had a terrestrial RSL of -85 dBmi at full transmitter power output of 29 dBm (36.5 dBm EIRP). (See Comsearch Figure 3.1-16 (A)). At full transmitter power output, there was no interference to the DirecTV or the EchoStar DBS receivers/decoders. (See Comsearch Figures 3.1-17 (A) & (B)).

Comsearch reference site 11, located 1400' from the transmit site at an azimuth of 344 degrees had a terrestrial RSL of -87 dBmi at full transmitter power output of 29 dBm (36.5 dBm EIRP). (See Comsearch Figure 3.1-18 (A)). There was no interference to either the DirecTV or the EchoStar DBS receivers/decoders at full transmitter power output. (See Comsearch Figures 3.1-19 (A) & (B)).

Another site, Comsearch reference site 12, was located 1100' directly north of the transmitter site. The terrestrial RSL at this site was -84 dBmi at full transmitter output power of 29 dBm (36.5 dBm EIRP) and once again no interference was experienced by the DirecTV or the EchoStar DBS receivers/decoders. (See Comsearch Figures 3.1-20 (A), 3.1-21 (A) & (B)).

CONCLUSIONS

While further testing is still needed, the basic concept of the Northpoint technology, transmitting terrestrially on co-channel satellite frequencies, appears to be viable as long as the terrestrial station is properly engineered. This first stage of testing demonstrated that as long as a Carrier-to-Interference ratio of at least 4.8 dB was maintained between the satellite signal and the terrestrial signal (with the terrestrial signal being the weaker signal) then there would be no perceptible interference into the DirecTV or EchoStar DBS systems. However this ratio is achieved, whether by antenna receive characteristics, power level adjustment, transmit antenna directionality or a combination of all of these, the end result is the same if the ratio is maintained - harmonious coexistence of co-channel terrestrially broadcast signals and satellite signals.

The tests clearly demonstrate that in a rural environment with no multi-pathing problems, a service area in excess of 10 miles could be achieved while maintaining an exclusion zone of less than 1/4 mile (1320'). Now that minimum required Carrier-to- Interference ratios are empirically known, and the size of the exclusion zone for certain power levels is known, further testing in a more urban environment can be accomplished without harmful interference to DBS service. In addition to the effect of multi-pathing, tests need to be conducted to determine the effect of different terrestrial transmit bandwidths on the DBS subscriber systems.

While further testing is of course necessary, the feasibility of Northpoint technology has been demonstrated. Since the Northpoint technology can be used to transmit terrestrially in the DBS band without causing interference to DBS subscribers, locally transmitted signals can be integrated into the existing DBS subscribers' equipment, with only minor modifications, so that local television stations, rather than distant signals, can be viewed. Implementing Northpoint technology can solve several problems for the DBS operators and eliminates their biggest barrier to being truly competitive to cable television.

Weather is obviously and justifiably a major concern to DBS operators, and even though the tests were performed under rainy conditions, atmospheric conditions will continue to be an issue. DCE notes, however, that one solution to this dilemma is to use an automatic power level control that monitors the RSL of the weakest usable DBS satellite and dynamically adjusts the terrestrial transmitter's output power accordingly.

DCE further notes that there are several ways to minimize the effect of the exclusion zone. First, in the case of an exclusion zone of 1/4 mile, if the terrestrial station was on a 1000' communication tower, the exclusion zone in the horizontal direction would be less than 900', a distance which would typically still be on the property of the tower. Second, in many cases, the terrestrial transmitter may be remotely located on top of a hill or mountain with other broadcast towers that have no residential or commercial properties within the exclusion zone. In instances such as this, the transmitter output power can be increased to maximize coverage while still limiting the exclusion zone to unpopulated areas. Another way to minimize the exclusion zone is to upgrade the antenna of any DBS subscribers in the exclusion zone by providing them with a non-offset antenna.

COMSEARCH

Leadership and Diversity for Wireless

DIRECT BROADCAST SATELLITE (DBS) MEASUREMENT REPORT

Prepared For

DIVERSIFIED COMMUNICATIONS ENGINEERING King Ranch, Texas

October 28, 1997

2002 Edmund Halley Drive • Reston, Virginia 20191, USA • 703.620.6300 FAX 703.476.2697

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

1.1 General

This report provides the test data obtained during tests conducted at the King Ranch in Texas from October 7 to October 10, 1997. The purpose of the measurements was to attempt to determine the impact of a known interfering signal level on the reception of a video signal from a Direct Broadcast Service (DBS) satellite. This information was used to determine the Carrier-to-Interference (C/I) levels required by the satellite receiving system. Signal reception from the DIRECTV and ECHOSTAR satellites were monitored.

In addition to the C/I measurements, measurements were made to determine the changes in the DBS satellite receive antenna gain toward the interfering source when the satellite antenna was rotated through 360 degrees at a fixed elevation angle of 32 degrees, as well as the changes in the DBS satellite antenna gain in the direction of the interfering source as the antenna elevation was changed from 30 to 75 degrees

1.2 Background

Before preparing a measurement test plan and performing any measurements, we thoroughly reviewed both a DIRECTV report, "Terrestrial Interference in the DBS Downlink Band," submitted to the Federal Communications Commission on April 11, 1994, and an Engineering Report in Support of 12 GHz Experimental Applications prepared by DeLawder Communications, Inc.

1.3 Assumptions and Constraints

- The gain of the horn antenna used at the transmitter location was 10 dBi.
- The waveguide connecting the power amplifier and the transmitting antenna was 70 feet. The losses are estimated to be 2.5 dB based on the waveguide losses specified as 3.58 dB per 100 feet.
- The Channel Master receive antenna supplied with the system was either defective or for a different frequency band; therefore it was decided to use the DBS RCA system antenna and amplifier for all tests.
- Two DBS systems were provided for the tests. The RCA system operated satisfactorily, while the ECHOSTAR system had a faulty LNB and could not be used. The RCA system was used to receive signals from both DIRECTV and from ECHOSTAR.

- The interfering levels measured needed to be adjusted to account for the interfering source antenna being linearly polarized, while the DBS antenna is circularly polarized.

- The resolution bandwidth of the spectrum analyzer was set to 1 MHz. For an interfering signal with a bandwidth of 8 MHz, a correction factor of 9 dB is required to establish the actual interfering level. For the 24 MHz satellite signal the correction factor required is 13.8 dB to establish the satellite signal level. The correction factor in dB is based on 10*log(Signal Bandwidth / Resolution Bandwidth).

SECTION 2

CALIBRATION AND METHODOLOGY

2.1 General

In this section we will address the following:

- Transmitter Output Calibration
- Calibration of the Comsearch 12.5 GHz test system
- Experimental Microwave System Calibration
- DBS System Configuration and Verification
- Interference Testing
- Microwave System Coverage Test
- DBS Antenna Pattern Tests

2.2 Transmitter Output Calibration

The terrestrial transmitter block diagram is presented in Figure 2.2-1. A WR75 flange to "N" was mounted to the output flange of the transmitter. An HP 11692D directional coupler was connected directly to the flange adapter. An HP 436A power meter with a 8481A sensor, a 20 watt load, and a termination were attached to the appropriate outputs of the coupler (Figure 2.2-2). The transmitter was verified to have an output level at full power of 29 dBm.

The Seavy antenna was connected directly to the output flange of the transmitter with 70 feet of Andrew EW127 waveguide (Figure 2.2-3). The estimated losses for the 70 feet is 2 dB based on the waveguide specification of 3 dB loss per 100 feet.

Terrestrial Transmitter Block Diagram

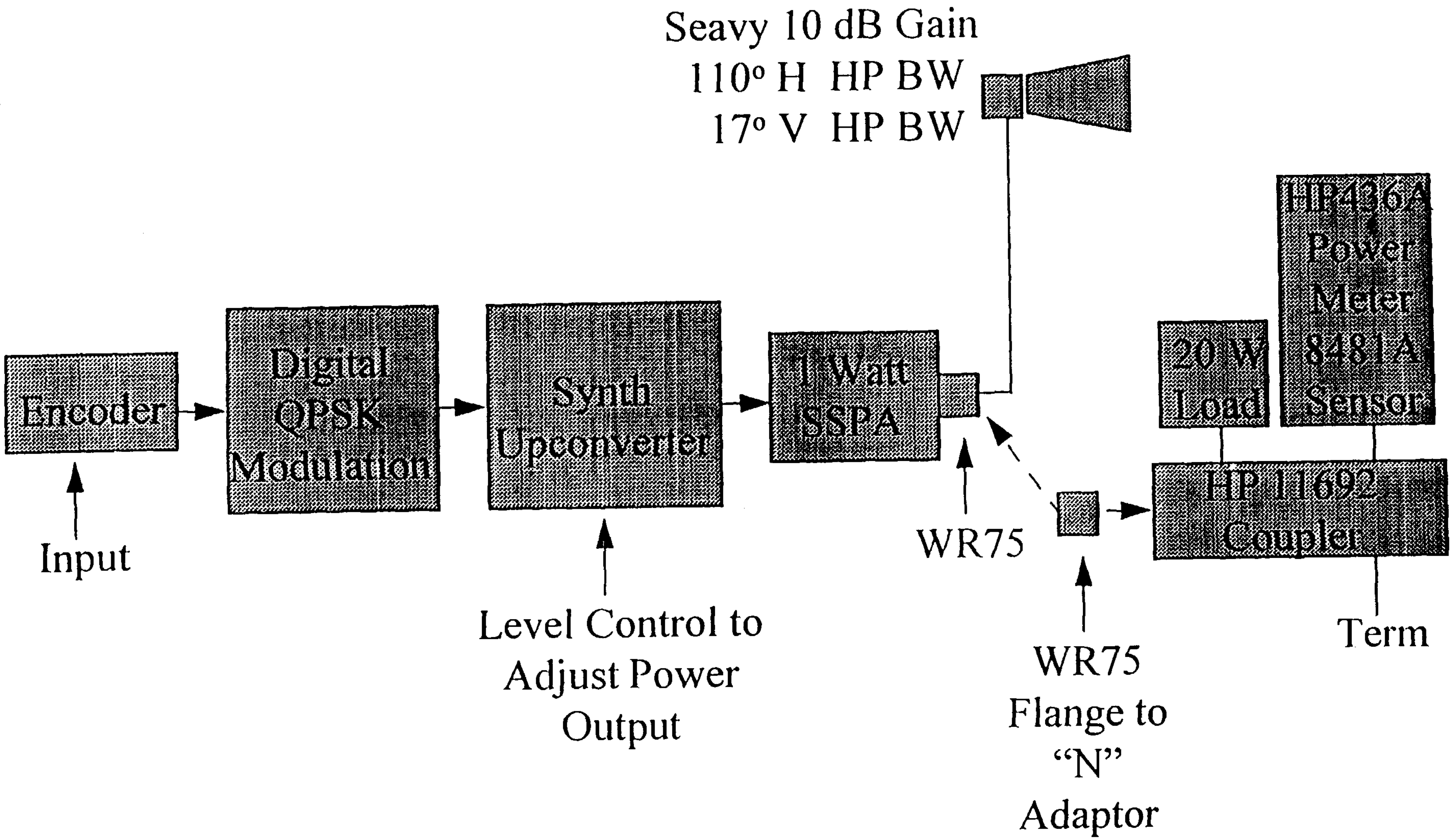


FIGURE 2.2-1

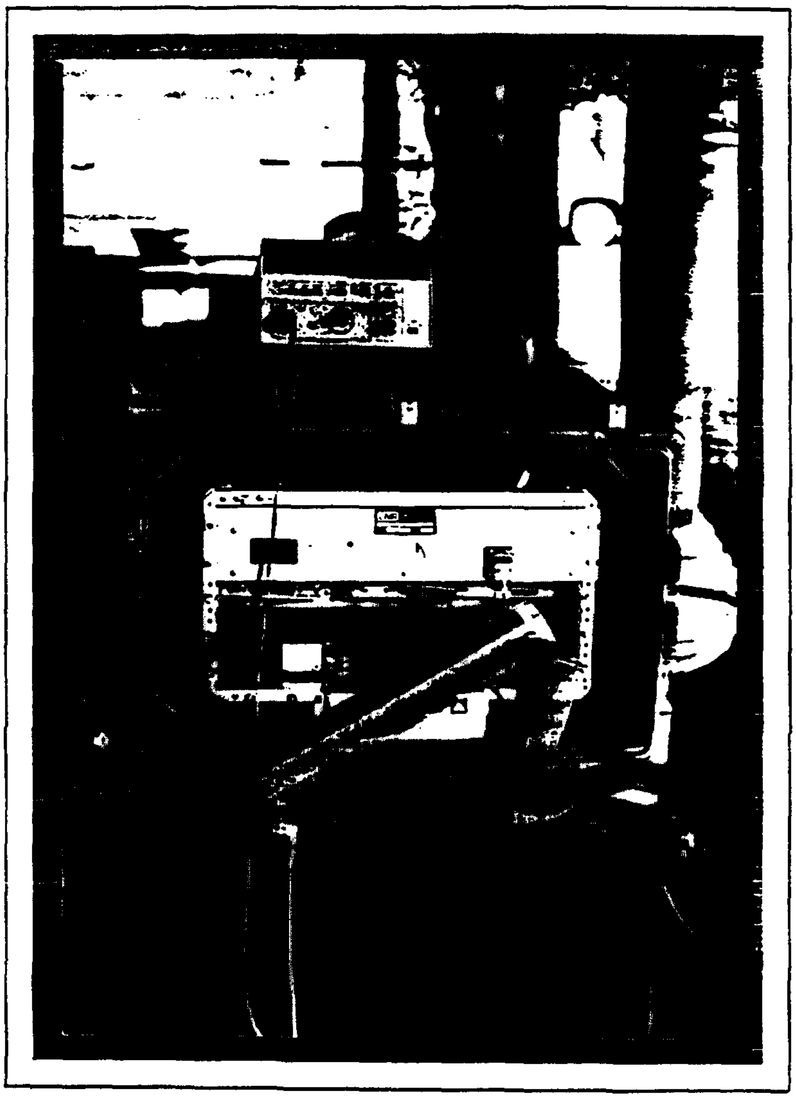


Figure 2.2-2 Transmitter Calibration Equipment

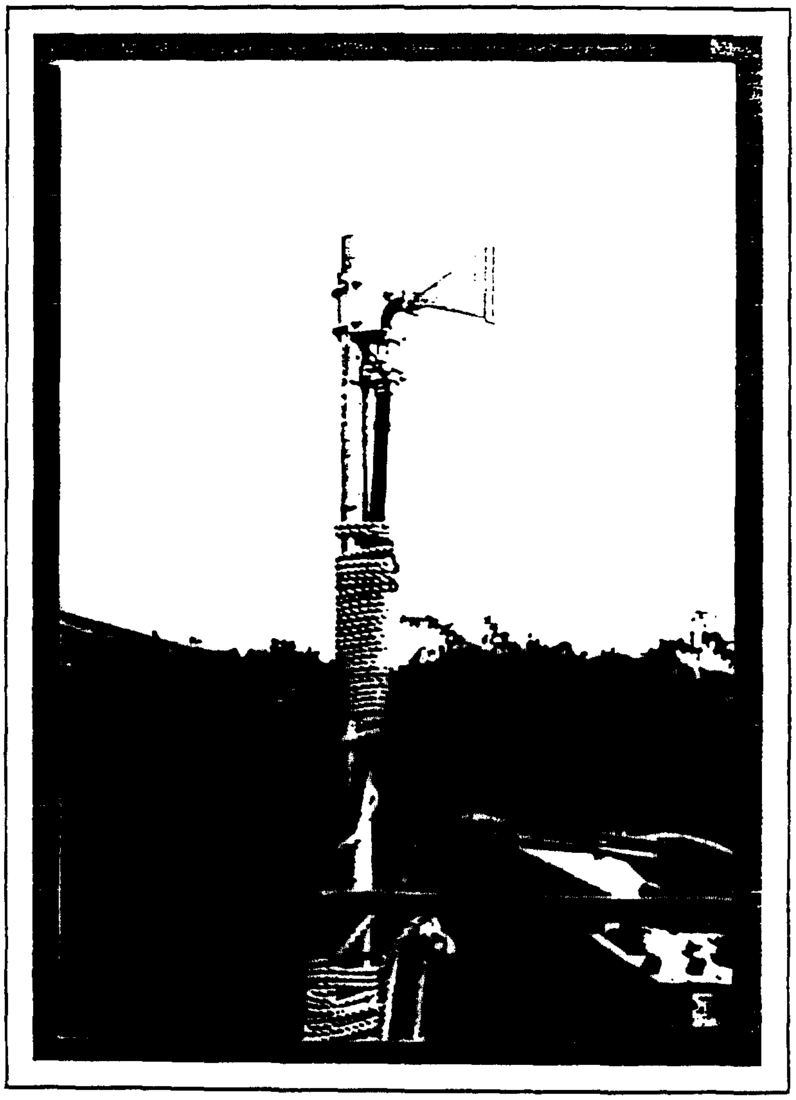


Figure 2.2-3 Transmit Antenna Mounted on Boom

2.3 Calibration of the Comsearch 12.5 GHz Test System

The Comsearch Test System Block Diagram (Figure 2.3-1) and System Photograph (Figure 2.3-2) comprise the following:

a. Ailtech 91892-1 reflector with 94614-1 horn
   Frequency range 12.0 - 18.0 GHz
   Gain at 12.5 GHz = 34 dB
   Beamwidth = 4 degrees

b. 25' Andrew FSJ4 1/2" cable
   or
   10' Andrew FSJ4 1/2" cable

   Note: System calibration was done with both cables (ref. calibration photos). The majority of tests utilized the 25' cable. The isotropic top reference in all 12 GHz photos will identify the cable utilized.

c. Amplica AXM 545304 low noise amplifier

d. Tektronix 494P spectrum analyzer w/ C5C scope camera

e. HP 8672A synthesizer

f. HP 436A power meter w/ 8481A sensor

A calibrated output from the synthesizer (-50 dBm) was inserted into the system and registered on the analyzer at -4 dBm or -9 dBm depending on cable used in order to establish an isotropic top reference on the analyzer (Figures 2.3-3 and 2.3-4).

At all measurement locations this test system was used to establish an isotropic level (LOS) from the transmitter and to verify output level variations.

Comsearch Test Set Block Diagram

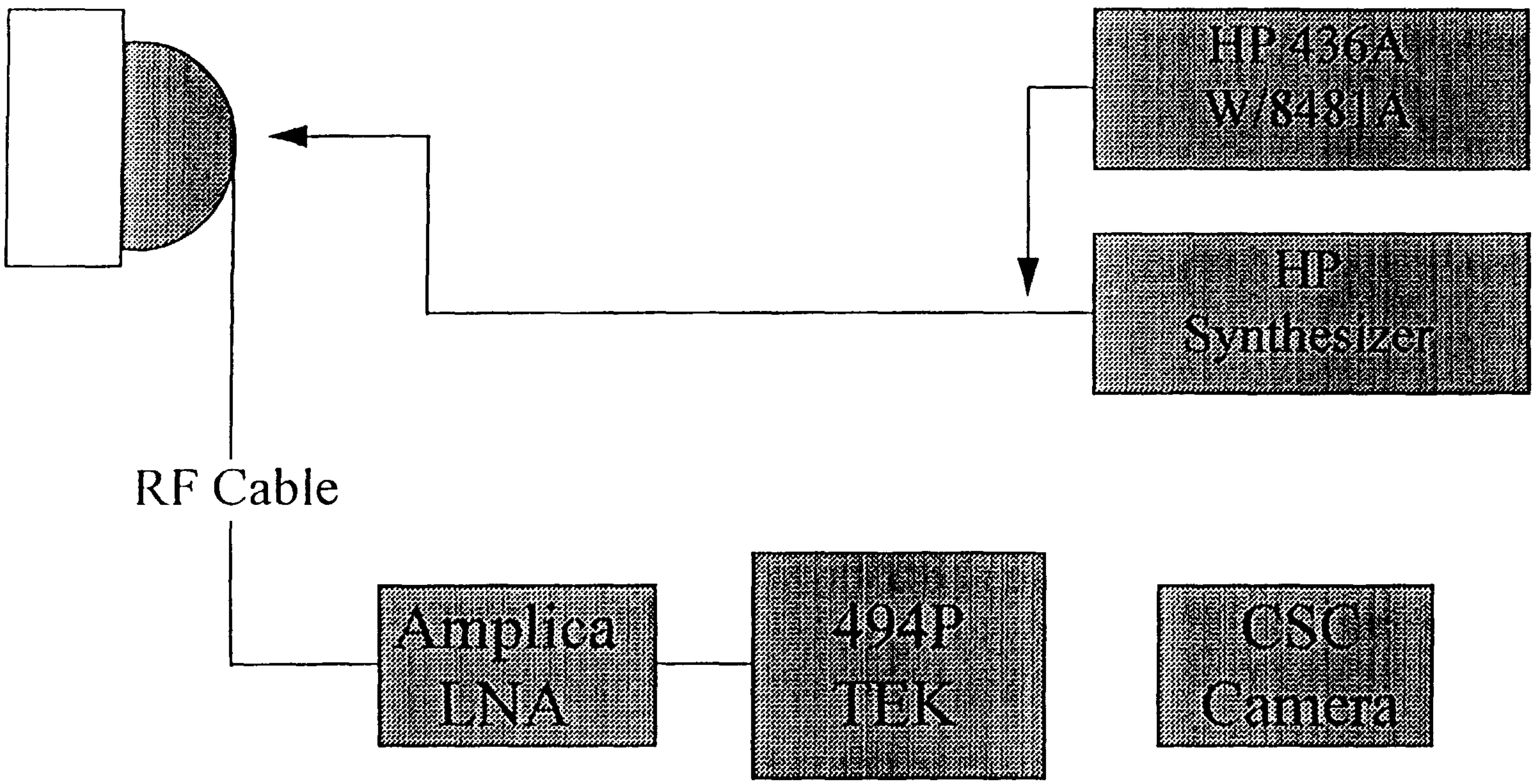


FIGURE 2.3-1

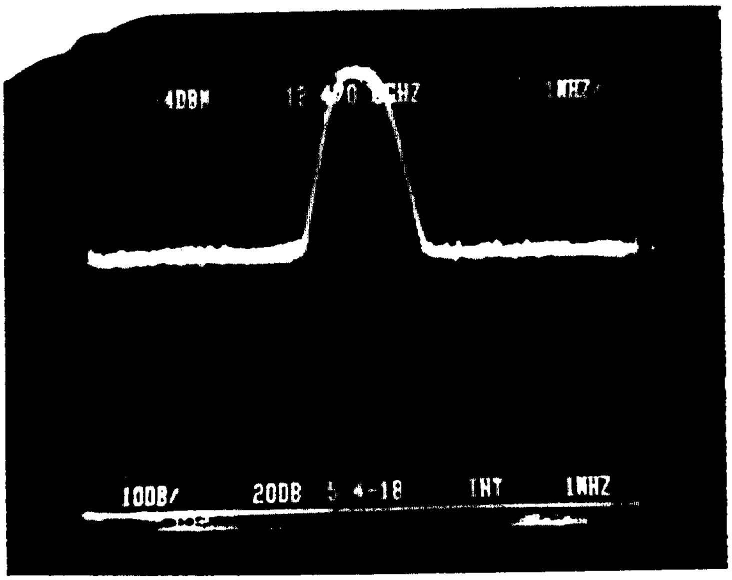
Figure 2.3-2 Comsearch Test Set/DBS Antenna Mount

King Ranch, Texas

Diversified Communications Engineering

Reference
Level
dBm_I

-84



Date: October 7, 1997
Calibration Photograph
Center Freq: 12470 MHz
Span/Div: 1 MHz
Res. Bandwidth: 1 MHz
Amplitude/Div: 10 dB

-4 dBm, 12470 MHz signal indication on the spectrum photograph represents a -50 dBm signal being injected at the point where the test cable connects to the output of the test antenna.

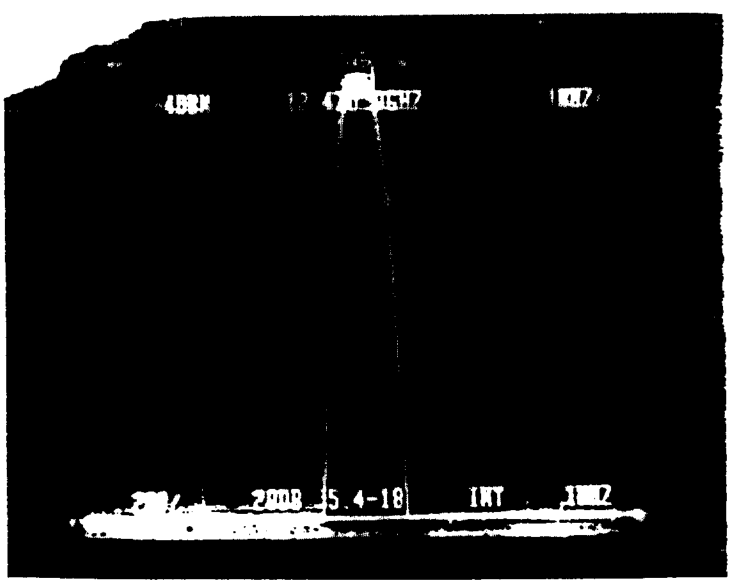
Top Reference Level is equal.
-50 dBm injected signal
-34 dB antenna gain

-84 dBm_I

(A)

Reference
Level
dBW_I

-84



Date: October 7, 1997
Calibration Photograph
Center Freq: 12470 MHz
Span/Div: 1 MHz
Res. Bandwidth: 1 MHz
Amplitude/Div: 2 dB

-4 dBm, 12470 MHz signal indication on the spectrum photograph represents a -50 dBm signal being injected at the point where the test cable connects to the output of the test antenna.

Top Reference Level is equal:
-50 dBm injected signal
-34 dB antenna gain

-84 dBm_I

(B)

Figure 2.3-3 RF Calibration Photograph (Short Cable)